PCT / SE 2004 / 0 0 1 1 1 1

PRV

PATENT- OCH REGISTRERINGSVERKET
Patentavdelningen

Intyg
Certificate

REGISTRERINGSVERKET • PATENT

Härmed intygas att bifogade kopior överensstämmer med de handlingar som ursprungligen ingivits till Patent- och registreringsverket i nedannämnda ansökan.

This is to certify that the annexed is a true copy of the documents as originally filed with the Patent- and Registration Office in connection with the following patent application.

(71) *Sökande* *Michael Abrahamsson, Vaxholm SE*
Applicant (s)

(21) *Patentansökningsnummer* *0400269-7*
Patent application number

(86) *Ingivningsdatum* *2004-02-10*
Date of filing

(30) *Prioritet begärd från* *2003-08-01 SE 0302152-4*

Stockholm, 2004-07-14

För Patent- och registreringsverket
For the Patent- and Registration Office

Gunilla Larsson

Avgift
Fee

PATENT- OCH REGISTRERINGSVERKET
SWEDEN

Postadress/Adress
Box 5055
S-102 42 STOCKHOLM

Telefon/Phone
+46 8 782 25 00
Vx 08-782 25 00

Telex
17978
PATOREG S

Telefax
+46 8 666 02 86
08-666 02 86

METHOD AND DEVICE FOR HEATING BY MEANS OF A GASEOUS MEDIUM

TECHNICAL FIELD

The present invention relates to a method for heating by means of steam, said steam being produced from water, energy for heating the water being provided by burning a fuel, according to the preamble of claim 1. The present invention further relates to a device for heating by means of steam, said steam being produced from water, energy for heating the water being provided by burning a fuel, according to the preamble of claim 7.

BACKGROUND

In boiler houses sulphur coating is formed on the inside of the boilers, i.e. extremely hard slag which is very difficult to remove. By conventional methods water is flushed in the boiler in order to unlace the slag, which is then scraped off. This is done by chimney cleaners and is very time consuming and does not provide a very good result. It is further a physically demanding task and expose the workers to hazards.

In exhaust air ducts such as e.g. kitchen ducts fat originating from food products and the like gets stuck on the inside of the ducts, on the bottom part and on the walls. The fat gets extremely hard and is very difficult to remove. The cleaning of the ducts is performed manually by conventional methods. The workers have to crawl inside the duct and scrape off the fat and collect it in buckets or the like. In buildings with several floors a narrow elevator is constructed where the worker sits and performs the cleaning. Also this does not give a satisfactory result and is a quite difficult task for the workers.

In the food industry, i.e. by chocolate manufacturing, slag is formed in the chocolate channels. In order to remove the slag products heating pistols are used, but they do not supply enough energy and are thus inefficient and do not give a satisfactory result. By releasing steam from boilers into the room attempts are made to clean the channels, but as the steam has to travel a long way it is not efficient at all.

In industrial chimneys the soot gets stuck on the inside of the chimney. The chimneys are cleaned by conventional cleaning, performed by chimney cleaners. This is a quite tricky and time consuming task, which can be physically demanding and hazardous for the workers. Another way of removing soot is to use ultrasonic sound, which is not an efficient method.

In drainage systems today, all cast iron systems are cleaned by high pressure flushing with water using a pressure greater than 100 bar. As a consequence they tend to break in joints, sealing joints etc. on occasions. In apartments the remains are discharged into the sewer systems, which is a problem.

The marine industry suffers from basically the above problems. They have kitchen ducts, drainage systems, chimneys etc.

By manufacturing of medicine in large tanks, the tanks are afterwards cleaned by means of hot water under high pressure. A very large amount of water is consumed and the result is not particularly good.

In the paper pulp industry the paper pulp gets stuck in e.g. the tanks, the conveyor belt where the pulp is dried, actually basically the whole line of production. The paper pulp becomes so hard that iron bars are needed to remove the pulp. The same type of problem also occurs by filter manufacturing.

Cleaning of oil in pipelines which gets stuck therein is currently done by using a sleigh or the like which cuts away the slag from the inner walls. By this method only a certain amount is removed due to e.g. the pipes not having an exactly circular shape. In underdeveloped countries the removing is done manually, which is very hazardous from an occupational point of view. In some cases the pipelines are simply replaced.

A problem by drilling in oil wells is that the boring bars tends to get stuck by the oil flowing down in the bore holes. There is a thermal rising force from the ground heat (hot air) rising in the holes. The rising air has a certain speed, which results in a cooling effect, cooling down the oil in the bore holes, making the oil sticky, resulting in the boring bars getting stuck. There are no efficient methods to solve this problem.

Shale oil lies under ground as bitumen. There are two known ways of extracting the oil. Either by open cut mine or by heating up the oil sand or by heating up or diluting the oil sand so that it becomes sufficiently fluid to be pumped up.

Both methods have major environmental disadvantages. Open cut mines require that two tons of tar sand is dug up for each barrel (159 litre) of oil produced. Only one fifth of the reserves of oil shale can be extracted with this technique. An army of trucks, trenching machines and bulldozers, which themselves require a lot of energy, are needed in order to excavate an area of the size of a large football ground every second day. After having extracted the shale oil the same operation is needed to fill up the open cut mine and restore nature. By using steam or chemicals for making the bitumen fluid means large risks for damaging the ground water. In order to extract shale oil in shale oil reserves using steam, steam is inserted into the ground in order to heat up the bitumen, which then becomes fairly liquid and can be retrieved. The steam is produced by large generators, which require a lot of electrical power, making the oil very expensive.

When an oil tanker sinks the water is often so cold that oil spill sinks and eventually lies on the bottom. This makes it very difficult to collect the oil.

It is also quite difficult to collect the oil in an oilslick. One way of preventing the oilslicks from drifting away is to provide a barrier around the oilslick, which has a certain depth, e.g. 2 meters. The problem of removing the oil in an efficient way still remains.

By fire fighting, the fires are mostly put out with water. A problem is that after the fire is put out the facility is soaked with water leading to large water damages. Another problem e.g. in large buildings such as skyscrapers the water is flushed from above as the ladders will not reach. This is not very efficient as the water turns into steam and is pushed away before reaching the core of the fire.

OBJECTS OF THE INVENTION

One object of the present invention is to provide a method for heating by means of steam, said steam being produced from water, energy for heating the water being provided by burning a fuel, such that heating becomes more efficient.

Another object of the present invention is to provide a device for heating by means of steam, said steam being produced from water, energy for heating the water being provided by burning a fuel, such that heating becomes more efficient.

SUMMARY OF THE INVENTION

These and other objects, apparent from the following description, are achieved by a method and a device for heating by means of steam which is of the type stated by way of introduction and which in addition exhibits the features recited in the char-

acterising clause of the appended claims 1 and 7. Preferred embodiments of the inventive method and device are defined in appended sub claims 2-6, and 8-18.

One advantage offered by the method according to the present invention is that it facilitates a way of removing slag from the inside of the boilers in boiler houses or the like which is quick, efficient and does not lead to any occupational hazards.

Another advantage offered by the method according to the present invention is that it facilitates a way of removing fat from the inside of exhaust air ducts such as kitchen ducts or the like which is quick, efficient and does not lead to any occupational hazards.

Yet another advantage offered by the method according to the present invention is that it facilitates a way of removing slag from the inside of channels by food manufacturing such as chocolate channels by chocolate manufacturing or the like which is quick and efficient.

A further advantage offered by the method according to the present invention is that it facilitates a way of removing soot from the inside of industrial chimneys or the like which is quick, efficient and does not lead to any occupational hazards.

A still further advantage offered by the method according to the present invention is that it facilitates a way of removing slag from the inside of containers by medicine manufacturing or the like which is quick and efficient.

Another advantage offered by the method according to the present invention is that it facilitates a way of removing hard paper pulp from the inside of containers by paper pulp manufacturing or the like which is quick, efficient and does not lead to any occupational hazards.

Yet another advantage offered by the method according to the present invention is that it facilitates a way of cleaning drainage systems such as cast iron systems or the like in apartment facilities or the like which is quick and efficient and at the same time eliminates the risk of damaging the pipes.

A further advantage offered by the method according to the present invention is that it facilitates a way of clearing oil stuck in pipelines, which is quick and efficient.

A still further advantage offered by the method according to the present invention is that it facilitates a way of preventing boring bars to get stuck by drilling in oil wells.

Another advantage offered by the method according to the present invention is that it facilitates a way of extracting shale oil in shale oil reserves in an efficient and power saving way.

Yet another advantage offered by the method according to the present invention is that it facilitates a way of collecting the oil from a sunk or sinking oil tanker in an efficient way.

A further advantage offered by the method according to the present invention is that it facilitates a way of collecting the oil from an oilslick in an efficient way.

A further advantage offered by the method according to the present invention is that it facilitates a way of heating up rooms such as e.g. house trailers which is very efficient and environmental friendly.

A still further advantage offered by the method according to the present invention is that it facilitates a way of putting out fires which is efficient and avoids water damages in the facility where the fire has been put out.

An advantage offered by the device according to the present invention is that it can be used for, in a quick, efficient and safe way, removing slag from the inside of the boilers in boiler houses or the like which is quick.

Another advantage offered by the device according to the present invention is that it can be used for, in a quick, efficient and safe way, removing fat from the inside of exhaust air ducts such as kitchen ducts or the like.

Yet another advantage offered by the device according to the present invention is that it can be used for, in a quick and efficient way, removing slag from the inside of channels by food manufacturing such as chocolate channels by chocolate manufacturing or the like.

A further advantage offered by the device according to the present invention is that it can be used for, in a quick, efficient and safe way, removing soot from the inside of industrial chimneys or the like.

A still further advantage offered by the device according to the present invention is that it can be used for, in a quick and efficient way, removing slag from the inside of containers by medicine manufacturing or the like which is quick and efficient.

Another advantage offered by the device according to the present invention is that it can be used for, in a quick, efficient and safe way, removing hard paper pulp from the inside of containers by paper pulp manufacturing or the like.

Yet another advantage offered by the device according to the present invention is that it can be used for, in a quick and efficient way, without damaging the pipes, cleaning drainage systems such as cast iron systems or the like in apartment facilities or the like.

A further advantage offered by the device according to the present invention is that it can be used for, in a quick and efficient way clearing oil stuck in pipelines.

A still further advantage offered by the device according to the present invention is that it facilitates a way of preventing boring bars to get stuck by drilling in oil wells.

Another advantage offered by the device according to the present invention is that it can be used for in an efficient and power saving way extracting shale oil in shale oil reserves.

Yet another advantage offered by the device according to the present invention is that it can be used for in an efficient way collecting the oil from a sinking oil tanker.

A further advantage offered by the device according to the present invention is that it can be used for in an efficient way collecting the oil from an oilslick.

A further advantage offered by the device according to the present invention is that it can be used for in an efficient and environment friendly way heating up rooms such as e.g. a house trailers.

A further advantage offered by the device according to the present invention is that it facilitates a way of putting out fires which is efficient and avoids water damages in the facility where the fire has been put out.

DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention will be had upon the reference to the following detailed description when read in conjunction with the accompanying drawings, wherein like reference characters refer to like parts throughout the several views, and in which:

Fig. 1 shows a device for heating by means of steam according to a first embodiment of the present invention;

Fig. 2 shows a device for heating by means of steam according to an alternative embodiment of the present invention;

Fig. 3 shows a device for heating by means of steam according to the alternative embodiment of the present invention attached to a channel.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a device for heating by means of steam according to a first embodiment of the present invention. The device 1 comprises a container 2, a burner 3 attached to the bottom of said container, for introducing heat into said container 2, and a water inlet 4 at the lower part of the container 2, preferably a pipe 4, for introducing water, and a reducing valve 5 connected to the pipe 4, said pipe 4, when located inside the container 2, preferably having helical shape rising upwardly in the container, and a pressure chamber 6 to the upper part of which the pipe 4 is connected, in which pressure chamber 6 water is intended to be introduced and boiled. The device further comprises an outlet 7, preferably a pipe 7, in the upper part of the pressure chamber 6, and an injection chamber 8 to the inner cavity 8a of which the pipe 7, via a safety valve 9 and a vent passage 10, said valve 9 and passage 10 preferably being located outside of the container 2, is connected. The device further comprises an overflow pipe 11 connected to the safety valve 9, said pipe extending down back into the lower part of the container where it is arranged to put out the flame from the burner 3. The injection chamber 8 further has an outer cavity 8b surrounding the inner cavity 8a, said chamber 8 being attached to the top of the container 2. The device further comprises a flame guard 12, preferably a perforated plate or the like constituting the top of the container 2 and the bottom of the injection chamber 8.

The steam is intended to be introduced into the inner cavity 8a of the injection chamber 8 via the pipe 7. The exhaust gas is intended to be introduced into the outer part 8b of the injection chamber 8 via the flame guard 12. The device further comprises a mixing chamber 13 constituting the upper part of the injection chamber, where steam, via openings in the inner part 8a of the injection chamber 8, is intended to be introduced in the outer part 8b of the injection chamber 8, and a steam heating hose 14 connected to the mixing chamber 13. The device further comprises a drainage pipe 15 attached to the lower part of the inner part 8a of the injection chamber 8, and a two-way valve16, for evacuating exhaust gas, attached to the outer part 8b of the injection chamber 8.

Water is introduced via the reducing valve 5 and then reaches the burner 3. It flows in the helical pipe and is pre-heated and then continues to the steam pressure chamber 6 where the water starts to boil and reaches a high pressure. The steam created continues to the safety valve 9, where the steam goes right through if not, for some reason a stop has occurred. If that is the case an overflow pipe 11 leading down to the burner 3 turns it out. The burner 3 is designed in such a way that if the flame goes out a small heat sensor automatically turns off the gas or the corresponding. If the safety valve is not triggered the steam continues to a vent passage 10 which functions in such a way that as soon as the steam has entered and reached a certain temperature, at 8 bar it is approximately 180°, it opens automatically and lets the steam pass through. If, by any circumstance, the burner 3 would not react properly the vent passage closes. This is however highly unlikely considering the capacity of the burner 3. The pipe coming from the vent passage 10 enters directly into the injection chamber 8, which consists of an inner chamber where the steam is injected and an outer chamber surrounding the inner, where the exhaust gas is introduced. The exhaust gases keep the steam heated already at this stage. The steam rises to the mixing chamber 13, where steam and exhaust gases are mixed. The injection chamber can as an alternative consist of two hoses having a certain desired length depending on the application, one hose surrounding the other (steam-jacketed) and be

injected just before it enters the mixture chamber 8. Condensation can be achieved in such a way that water flows which the steam can carry flowing down in a drainage pipe 15 and further down in the sink. If the burner 3 would go out the water is prevented from rising and flowing in to the burner 3. At the top of the steam generator a flame guard, designed as a perforated plate, is arranged, as a safety precaution, in such a way that the flames will not be able to rise higher. In addition there is a two-way valve 16 located at the injection chamber 8 for evacuating exhaust gases, so that the device can be used for example for cleaning of tanks for medicine manufacturing, at the end of the cleaning process, when it is desired to get the tank disinfected, by only injecting steam in the tank. At the end there is a steam heating hose 14 provided for transporting the steam and exhaust gas mixture.

When the exhaust gases are injected into the steam they are intended for heating up desired cavities for the steam such that the steam then is able to operate. During that time the steam protects against fire due to heating by the exhaust gases. When the exhaust gases have heated the cavity to the desired operating temperature, the steam starts loosening up the slag on the surfaces while at the same time the exhaust gases keep the surfaces heated for the steam. Thus, the exhaust gases transports the steam and keeps it warm in an efficient way. This results in a very high efficiency.

Fig. 2 shows a device for heating by means of steam according to an alternative embodiment of the present invention. The device comprises a container 20 having an air inlet 21, a gas inlet 22, a water inlet 23, a steam outlet 24, an exhaust gas outlet 25 and an outlet 26 for the steam and exhaust gas mixture, and a gas burner 3, for burning combustion gases, located inside the container 20. The gas burner 3 is intended to be supplied with air through the air inlet 21, preferably from a fan, and with combustible gas such as propane, butane, natural gas or the like through the gas inlet 22. The air inlet 21 and the gas inlet 22 are arranged in such a way that the air is mixed with the gas, which is ignited whereby a gas flame appears. The water inlet 23 is arranged in such a way that the water fed through the water inlet 23, which

preferably is a pipe shaped as a spiral inside the container 20, is heated by means of the burner 3 to steam-generating heat. The steam outlet 24 and the exhaust gas outlet 25 are arranged in such a way that they form a common cavity 26 where steam formed from the heated water in the spiral and exhaust gas produced from burning the combustion gases are intended to be mixed and further be introduced into a cavity, such as a ventilating duct, through the outlet 27.

Fig. 3 shows an example of an application according to the invention, using the device in fig. 2, where the mixture of exhaust gas and steam is introduced from the outlet 27 into the entire length of a channel 30 such as a ventilating duct 30 starting from the bottom and out through the upper part of the ventilating duct 30 by means of automatically heating controlled exhaust valves 31. The mixture of exhaust gas and steam heats the inside of the ventilating duct from 10°-90° with a mixture of steam and exhaust gas of 140°-200°, which melts the impurities 32 such as fat and oil deposits 32 on the inside of the ventilation duct 30. The melted fat and oil deposits 32 flows due to their own weight down to the bottom of the ventilating duct to the pipe for runoff of fat and oil to a collecting vessel 33 for fat separation, where fat and oil are cooled and transforms into solid state and can easily be disposed of.

Steam, which is cooled in the process, reverts, i.e. is condensed to water and flows back in the lowest part of the ventilating duct and is collected in the collecting vessel 33 ready to be removed after having finalised the cleaning of the ventilating duct.

During the process the mixture is risingly led to the top of the channel where preferably a temperature regulated valve 31 is located. The valve 31 is arranged to be controlled by temperature in such a way that the inner sides of the ventilating duct 30 are supplied with a proper amount of combustion gas and steam for reaching a temperature for melting the impurities consisting of fat, oils mixed with dust, soot and slag particles, which are stuck on the inner sides of the ventilating duct 30. The

control of the valve 31 is designed in such a way that the gas and steam mixture is maximally used for the cleaning of the channel regarding supplied energy.

As implied above the exhaust channel can be a ventilating duct such as a kitchen duct, or a chimney or the like. The invention, however, facilitates introducing the mixture into any kind of cavity, where the cavity apart from an exhaust channel can be e.g. a tank; drainage system; chimney; boiler; pipeline; oil container; oil well; oil shale; oilslick or the like. Different applications of the invention will be further elucidated below.

The device according to the present invention can thus in another application be used for, in a quick, efficient and safe way, removing slag from the inside of the boilers in boiler houses or the like.

The device can in a further application as mentioned above be used for, in a quick, efficient and safe way, removing fat from the inside of exhaust air ducts such as kitchen ducts or the like. By introducing the steam and exhaust gas mixture into the channel the fat becomes as loose as cooking oil, floats down and is collected in a container at the bottom. The fat is then preferably cooled down and becomes hard, and can easily be removed. This is explained further above.

The device can in a further application be used for, in a quick and efficient way, removing slag from the inside of channels by food manufacturing such as chocolate channels by chocolate manufacturing or the like. By introducing the steam and exhaust gas mixture into the channel the slag products are liquefied and can be removed. This is by way of example. The invention can of course be used in any cavity where vegetable fat is present.

The device can in a further application be used for, in a quick, efficient and safe way, removing soot from the inside of industrial chimneys or the like. The top of the

chimney is sealed. The mixture with a suitable temperature is then introduced. By the heat the soot becomes heavy and falls down, is shoved together and can then easily be removed by transport.

The device can in a further application be used for, in a quick and efficient way, removing slag from the inside of tanks by medicine manufacturing or the like which is quick and efficient. By introducing the mixture at preferably 125-140° the slag products are removed and the tank is disinfected and ready for use. In order to get the tank fully disinfected the exhaust gases are diverted at the end such that only steam is released. This can also be done with a petroleum tank, which then eliminates the risk of fire.

The device can in a further application be used for, in a quick, efficient and safe way, removing hard paper pulp from the inside of containers by paper pulp manufacturing or the like. By introducing the mixture in the container the hard paper pulp stuck on walls is loosened up by the heat and can easily be removed such that the container again is ready for use.

The device can in a further application be used for, in a quick and efficient way, without damaging the pipes, cleaning drainage systems such as cast iron systems or the like in apartment buildings or the like. By introducing the steam and exhaust gas mixture into the pipes they are cleaned very efficiently without any risk of being damaged in the process. One way of doing this is to attach a pipe tee to the outgoing pipes, presumably located in the basement, then connecting the device for producing the mixture, and then, using the temperature regulator on the roof, introducing the steam and exhaust gas mixture, heating the drainage and consequently the fat without pressure floats down into a collecting barrel or the like.

The device can in a further application be used for, in a quick and efficient way clearing oil stuck in pipelines. By introducing the mixture in the pipelines the oil

stuck in the pipelines is cleared. How big a section of the pipeline that can be cleared depends on the size of the gas burner. Theoretically a section of up to one kilometre could be cleared. One way of practically doing this is to use trucks for accessing the pipelines, onto which trucks the mixture device and a water container are arranged.

The device can in a further application be used for, in a quick and efficient way preventing boring bars to get stuck by drilling in oil wells. The boring bars get stuck because of the oil being cooled down due to the thermal rising force from the geothermal heat, i.e. hot air, which when moving at high speed gives a cooling effect. By introducing the steam and exhaust gas mixture into the ground the oil is prevented from being cooled down and thus the risk of the boring bars getting stuck is eliminated.

The device can in a further application be used for in an efficient and power saving way extracting shale oil in shale oil reserves. The shale oil lies under ground as bitumen. Instead of introducing steam in order to liquefy the bitumen, requiring a lot of power, the steam and exhaust gas mixture is introduced, requiring much less power. The presence of bitumen lies in many cases under natural gas reserves, and thus in these cases by combusting the natural gas, it can then be mixed with steam for producing the steam and exhaust gas mixture. The combustion gas is thus in these cases "free of charge".

The device can in a further application be used for in an efficient way collecting the oil from a sunk or sinking oil tanker. In the case of sinking oil tankers the water is usually so cold that the oil starts sinking to the bottom. By introducing the mixture into the oil compartment in the sinking oil tanker via hoses and heat up the oil, it can easily be retrieved.

The device can in a further application be used for in an efficient way collecting the oil from an oilslick. By covering the oilslick with a blanket or the like, and the introducing the steam and exhaust gas mixture under the blanket and into the oilslick, the oil is heated and becomes more liquid. The temperature of the oil is preserved by the blanket, and thus the liquid oil can easily be sucked up.

The device can in a further application be used for in an efficient way heating up rooms such as e.g. house trailers. The steam and exhaust mixture is introduced into a heat exchanger. The steam rises and heats the heat exchanger until the steam has been cooled down to approximately 78° C when condensation occurs. The steam flows down again and the process starts all over. By cooling the exhaust gases in the form of accumulated water below the dew point it flows down again. The old exhaust gases are filtered via water filters such that they can be re-used, i.e. no exhaust opening such as a chimney or the like is needed, and consequently no exhaust gases are released to the environment. Instead of using e.g. water with a temperature of 8° C, water with a temperature of e.g. 20° C is received. Therefore, as it is a closed system, the heating process becomes faster. A very high temperature difference (ΔT) is achieved. Instead of having tap water on the reduce valve 5, a circulation pump is used. By filtering in normal active coal pure water is provided again.

The device can in a further application be used for in an efficient way put out fires. By introducing the steam from the device from underneath the core of the fire is reached without getting in contact with the flames. The fire is then put out from underneath and the oxygen is taken away at the same time as it moistens all the surfaces. Either a perforated hose is used which is unrolled in the floor underneath, or alternatively a hose is harpooned into the floor being on fire.

Above the invention has been described in connection with preferred embodiments. Of course further embodiments as well as minor changes and additions may be imagined without deserting the basic inventive idea.

The above mentioned applications of the invention are only examples. There are of course other areas where the invention offers advantages. In the oil industry, apart from what is mentioned above, also, for example, cleaning of oil tanks and cleaning of the ventilating ducts leading the oil mist away for the refining. In the marine industry, cleaning of heat exchange systems, cleaning of exhaust gas channels/ chimneys from engines etc., cleaning of drainage systems in there entire length, cleaning of tanks from oil, disposals and night soil, and cleaning of kitchen ducts from restaurant kitchens, are examples of applications. In the food industry cleaning and disinfection of preparation vessels, cleaning of ducts, and cleaning of production lines etc. Manufacturing of medicine is as mentioned cleaning and disinfection of preparation tanks. In building facilities for example, thawing of down pipes and spouts during winter season and as mentioned cleaning of drainage pipes. In paper pulp industry, cleaning of exhaust air duct systems is another application. In areas where today conventional steam engines are used, as e.g. thawing of road culverts, street gullies, water and drainage pipes, bore holes, casting moulds etc. Other areas are hardening of concrete during the winter season, heating of larger PVC pipes and many others.

As an alternative embodiment to using exhaust gases from combusted gaseous elements such as butane, propane, natural gas or the like, exhaust gases from combusted liquid elements such as diesel oil or the like, or exhaust gases from combusted solid elements such as chip, coal or the like can be used.

Claims

1. Method for heating by means of steam, said steam being produced from water, energy for heating the water being provided by burning a fuel, **characterised by** the steps of:

- mixing the steam with exhaust gas from combustion of said fuel; and
- using said mixture for heating purposes.

2. Method according to claim 1, **characterised in that** said fuel is a gaseous medium, for example butane, propane, natural gas or the like, or a liquid medium, for example diesel or the like, or a solid medium, for example coal or the like.

3. Method according to claim 1 or 2, **characterised by** the step of introducing said mixture into a cavity for heating.

4. Method according to claim 3, **characterised in that** said cavity constitutes anyone of the following: exhaust channel; tank; drainage system; chimney; boiler; pipeline; oil container; oil well; oil shale; oilslick, oil tanks, ventilating duct, heat exchanger system, preparation vessels, down pipe and spout, exhaust air system, cavity on fire, road culverts, street gullies, water and drainage pipes, bore holes, casting moulds, PVC pipes or the like.

5. Method according to any one of the preceding claims, **characterised by** the step of regulating the temperature of said mixture.

6. Use of steam produced according to any one of claims 1, 2, 3 and 5, for fire fighting.

7. Device for heating by means of steam, said steam being produced from water, energy for heating the water being provided by burning a fuel, **characterised in** an arrangement for mixing the steam with exhaust gas from combustion of said fuel.

8. Device according to claim 7, **characterised in that** said fuel is a gaseous medium, for example butane, propane, natural gas or the like, or a liquid medium, for example diesel or the like, or a solid medium, for example coal or the like.

9. Device according to claim 7 or 8, **characterised by** means for introducing said mixture into a cavity for heating.

10. Device according to anyone of claims 7-9, **characterised in that** said cavity constitutes anyone of the following: exhaust channel; tank; drainage system; chimney; boiler; pipeline; oil container; oil well; oil shale; oilslick, oil tanks, ventilating duct, heat exchanger system, preparation vessels, down pipe and spout, exhaust air system, cavity on fire, road culverts, street gullies, water and drainage pipes, bore holes, casting moulds, PVC pipes or the like.

11. Device according to any one of claims 7-11, **characterised in** a container (2, 20) a pipe system (4, 23) arranged in said container (2, 20) for introducing water and for extracting steam from said container (2, 20) and a burner (3) for heating water and steam in said pipe system and means for extracting exhaust gases from combustion by means of said burner (3) and means for mixing said steam and said exhaust gases.

12. Device according to claim 11, **characterised in** a pressure chamber from which steam is extracted.

13. Device according to claim 11 or 12, **characterised in** a cavity (13, 26) in which said steam and said exhaust gases are mixed.

14. Device according to anyone of claims 11-13, **characterised in** an injection chamber (8) arranged upstream in relation to the mixing chamber (13) comprising a separate cavity (8a) for said steam and a separate cavity (8b) for said exhaust gases, said steam being heatable by said exhaust in said injection chamber (13).

15. Device according to claim 14, **characterised in** the injection chamber (8) having an inner cavity (8a) for said steam and an outer cavity (8b) for said exhaust gases, said cavities preferably being concentrically arranged.

16. Device according to claims 14 or 15, **characterised in that** said injection chamber (8) comprises means for extracting steam unmixed with exhaust gases.

17. Device according to anyone of claims 11-16, **characterised in that** steam is extracted via a safety valve (9) and a vent passage (10).

18. Device according to any one of claims 7-17, **characterised in** means for regulating the temperature of the mixture.

ABSTRACT

A method for heating by means of steam, said steam being produced from water, energy for heating the water being provided by burning a fuel, wherein the steam is mixed with exhaust gas from combustion of said gaseous medium; and wherein said mixture is used for heating purposes. The invention also relates to a device for heating by means of steam.

(Fig. 1)

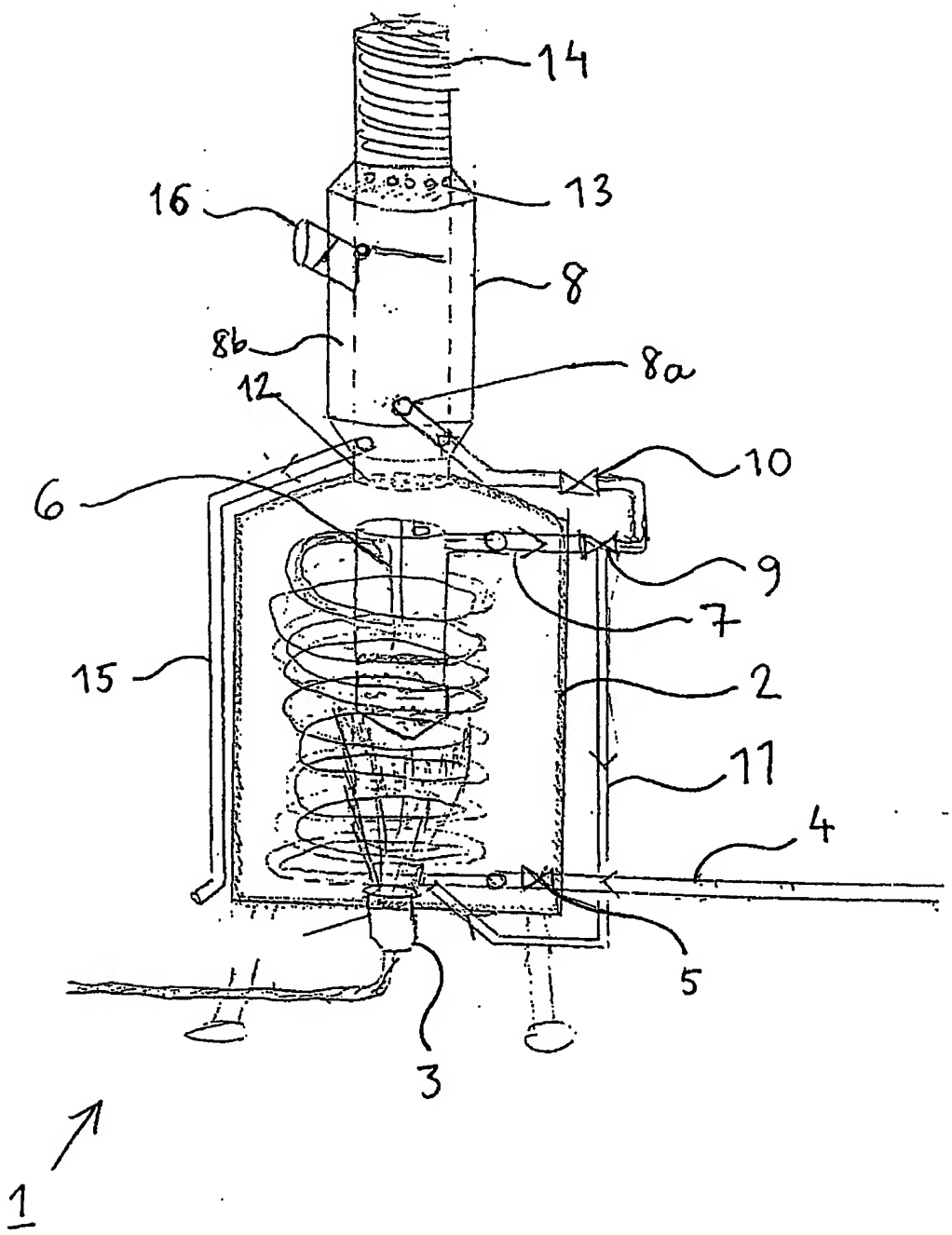

Fig. 1

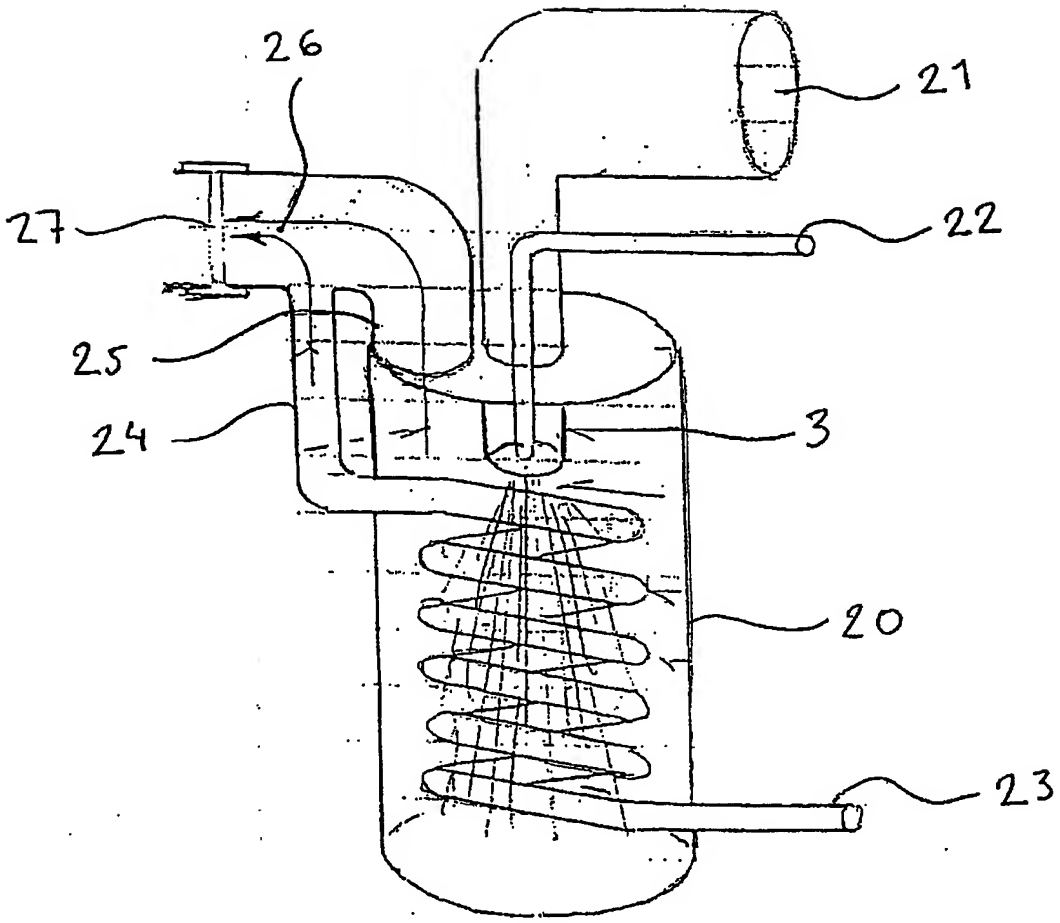

Fig. 2

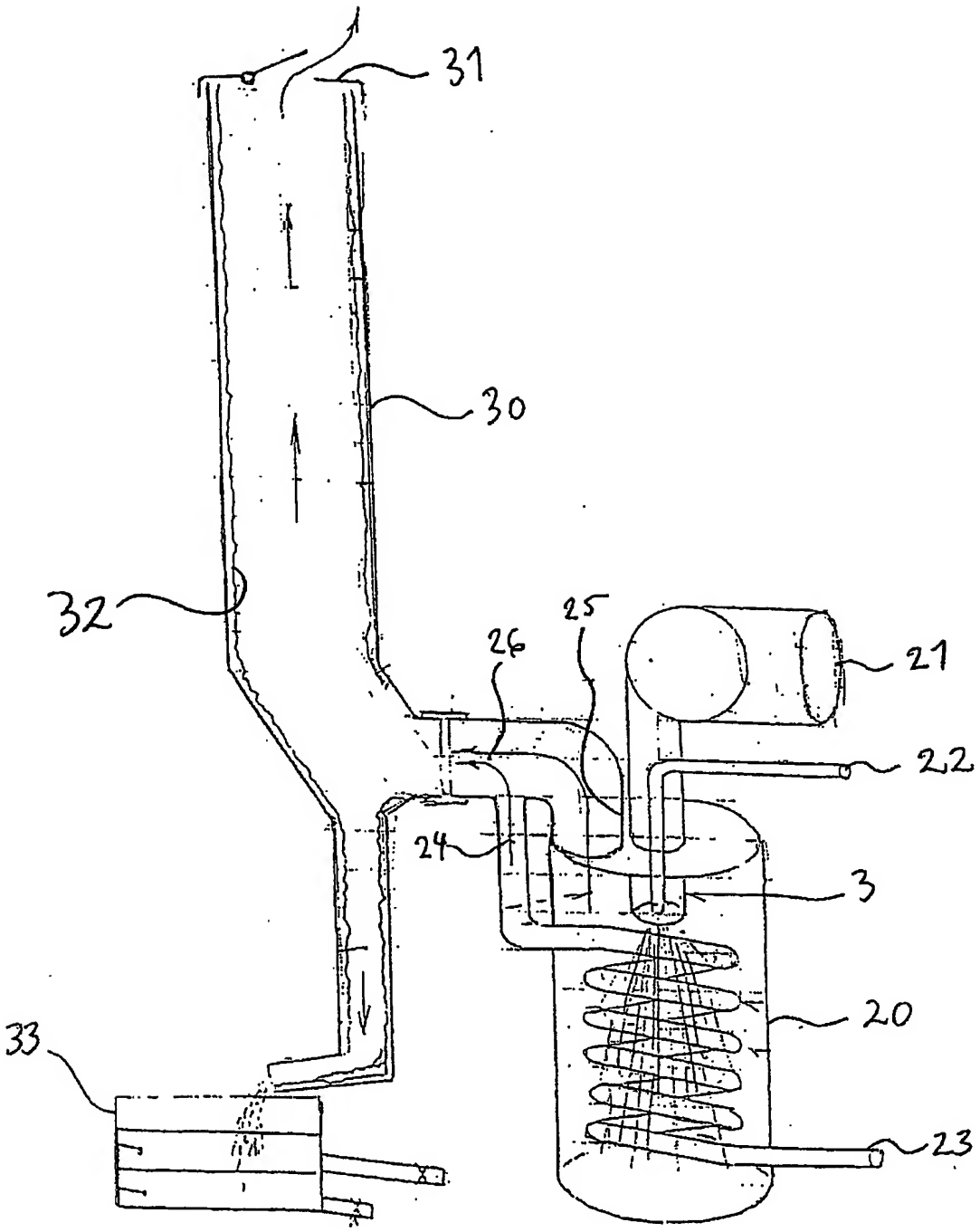

Fig. 3

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.